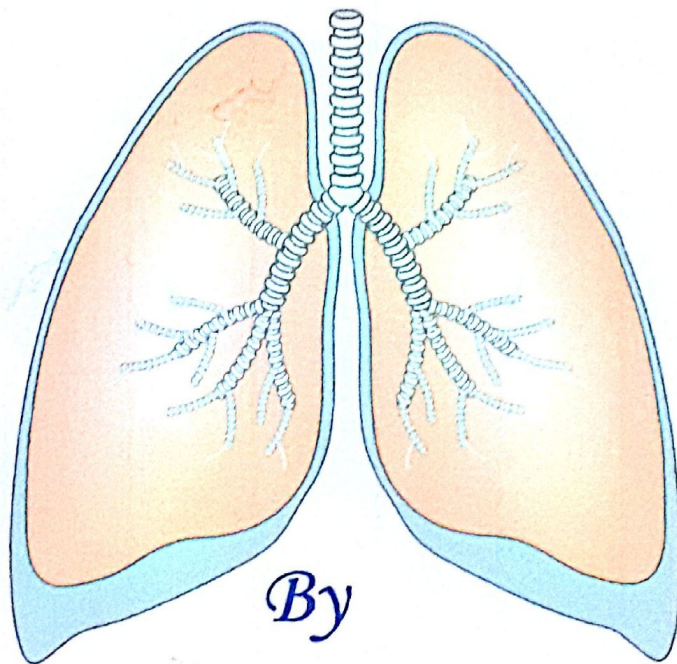


PPG

Common Pediatric Chest problems

Suggested Protocols



By

Pediatric Protocols Group

PPG

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part I

Preface

We have the honor to represent our trial for designing the proper protocols for common pediatric problem. We hope to pave the way for our colleagues pediatric residents to be at the target in simple, clear, scientific and applicable way .

We hope to provide a beneficial booklet in your hand helping you to take a rapid and correct decisions for treatment of children and help you to be a safe pediatrician.

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1-VIRAL CROUP

- **Viral croup**(acute laryngotracheobronchitis) is the most common cause of upper respiratory tract obstruction.
- **Main cause:** viral especially parainfluenza virus (75%).
- It occurs mainly in late fall and winter.
- Most patients with croup are between 6 months to 5 years (peak age: 2nd year of life).

NB croup after 5 years old mycoplasma infection may be suspected

- Recurrence may be frequent from 3 to 5 years of age
- 15% of cases have a strong positive family history of croup

Rules for croup

- Assessment of severity is the first step in management
- Most children who seek medical attention have mild self-limited symptoms and can be successfully managed at home
- Only 8-15% of patients come to emergency room need hospital admission
- Only 1% need PICU admission
- Corticosteroid and nebulized adrenaline are the corner stone in management

Step 1 (diagnosis)

- A prodroma of low grade fever, nasal stiffness, rhinorrhea and mild cough for 1-3 days before the symptoms of obstruction
- Then the patient develops:
 - barking cough
 - hoarseness of voice
 - inspiratory stridor
 - variable degree of respiratory distress
- The fever can persist (mainly low grade), or increase up to 39-40°C and some patients are afebrile
- Symptoms worsen at night
- Course < one week and most children improve within two days
- agitation (due to respiratory distress) increases the narrowing of the airway

NB: Viral croup is a clinical diagnosis and no investigations are recommended

Step 2 (Differential Diagnosis)

Consider another diagnosis rather than viral croup if the following criteria are detected:

- Acutely present after episode of choking
 - OR**
 - extreme acute onset without URT prodromal fever or barking cough
- Consider foreign body**

- Toxic ,drooling,
 - absence of barking cough
 - high grade fever
 - severe respiratory distress
- Consider acute epiglottitis**

- Toxic ,drooling,
 - dysphagia,
 - meningismus
- Consider retropharyngeal abscess**

- Recurrent stridor
 - not respond to usual treatment
 - in infant less than 6 months
- Consider congenital air way anomaly**

- Abrupt onset at mid night
 - Recurrent, transient,
 - without URT prodroma or fever and without known upper airway anomalies
- Consider spasmodic croup**

step 3 (assessment of severity)

items	mild	Moderate	Severe
Barking cough	occasional	Frequent	continuous
Stridor at rest	no	Yes	Yes
RR	normal	Mild tachypnea	Severe tachypnea
retraction	no	Mild	Severe (indrawing of sternum)
cyanosis	no	No	May be present
agitation	no	Intermittent irritability	Continuous agitation
O2 sat	Normal	normal	<92%

N.B: croup is a disease of upper respiratory air way obstruction and alveolar gas exchange is normal so hypoxia and low o₂ saturation are seen only when complete air way obstruction is imminent.

Step 4 (plans of treatment: plan A,B,C)

PLAN A FOR MILD CASES (HOME MANAGEMENT)

A. Instructions:

- Child shouldn't be sent to day care or school as they are infectious in first 3 days
- Try to make the infant calm and prevent crying
- Allow the child to breath cool air at night by opening window or door
- Warm clear fluids for cough
- Keep the child head elevated
- Parents should sleep in the same room of the child
- Mist treatment (not warm humidifiers) is recommended
- Avoid smoking at home

B. medications

- Only single dose of dexamethazone (0.6mg per kg maximum 16 mg) is recommended by the easier route to child
- **NB:** inhaled budesonide (2mg) single dose can be used as alternative to dexamethazone
- For fever, use acetaminophen or ibuprofen
- Nebulized adrenaline is not routinely recommended in mild croup
- Avoid sedatives, decongestant, cough medicines
- Antibiotics are not recommended

C. Inform the patient about warning signs including:

- Difficult breathing
- Severe, frequent cough spells
- Drooling or difficult swallowing
- fever $> 39^{\circ}\text{C}$ > 2 days
- Symptoms of mild croup > 7 days

PLAN B (HOSPITAL MANAGEMENT) FOR MODERATE CASES

1. Step 1 at ER

- Single dose of dexamethazone or inhaled budesonide (2mg single dose)
- nebulized adrenaline which can be repeated after 15 minutes
- Humidified o₂ if $\text{SpO}_2 < 92\%$

- Avoid unnecessary invasive maneuvers
- After 1-2 hours reassess the child
 - **If the patient improved** :discharge home with the same instruction of mild croup and follow up after 24 hrs
 - **If not improved** :admit to ward

Indication of ward admission

- persistent or deteriorating RD after initial ER treatment
- severe stridor at rest
- Severe dehydration and poor oral intake
- Age<6months
- Recurrent visits to ER within 24 hours
- Inability of the family to comprehend the instructions

2. Step 2 Ward management include:

- Another dose of dexamethasone after 24 hours from the initial dose
 - Repeated nebulized adrenaline every 6 hours the frequency of adrenaline can be increased up to every 2 hours
 - Humidified O₂ supplementation if SPO₂ 92%
 - IV fluid if the patient can't take oral
 - Antibiotics are not recommended in treatment of viral croup
 - Assess the patient every 12 hrs
- **if improved** discharge home on same instructions of plan A and follow up after 24 hrs

What are the criteria for discharge?

- No stridor at rest
 - Normal O₂ level in room air
 - Normal color
 - Normal level of consciousness
 - Good toleration to oral feeding
 - Care givers understand the indication for return
- **If not improved** after 2 days, you have to exclude other causes of croup and investigate according to clinical assessment and if the patient deteriorated admit in PICU

Plan C for (severe croup)

Step 1: ER management:

- Single dose of dexamethasone or inhaled budesonide (2mg single dose)
- nebulized adrenalin which can be repeated after 15 minutes
- Humidified O₂ if SPO₂<92%
- Avoid unnecessary invasive maneuvers

- if improvement occur → ward admission and manage the case with plan B
- but if still severe → prepare for PICU place.

Indications for PICU admission:

- Respiratory failure needs intubation
- Severe croup with DCL or poor air entry
- Severe symptoms need nebulized adrenaline <2 hrs as they need close cardiac monitoring
- moderate or severe croup in high risk child

Step 2: PICU management

- Check for other causes because viral croup is extremely rare to need ICU care
- Supplemental O₂
- Monitor HR, RR, SPO₂
- Continuation of ward treatment IV dexamethasone, adrenaline nebulizers (even every <2 hours under continuous cardiopulmonary monitoring)
- Obtain ABG & chest x ray to exclude complications as pneumothorax and any concomitant cause of RD.
- The need for intubation should be anticipated in children:
 - severe cases deteriorating despite of medical treatment.
 - progressive respiratory failure.

Precaution of intubation:

- anesthesiologist should be called for intubation
- Skilled ENT consultant should be called if urgent tracheostomy is needed
- Use inhalational not IV anesthesia
- Tube size 0,5 to 1 cm less than typically used
- Nebulized adrenaline and IV dexamethasone (0.5mg/kg/dose 6-12 hours before extubation and then every 6 hours for 6 doses after extubation)

Doses of drugs used in croup

- **Dexamethasone:** 0.6 mg / kg (maximum 16mg)

N.B oral dexamethasone preparation (1mg/1ml) has unpleasant taste and IV dexamethasone preparation (4mg/1ml) can be given oral in a solution

- **Budesonide** can be used as alternative to dexamethasone as single dose inhalation particularly for children who are vomiting

- Dose: 2mg
- Available preparation

1. Pulmicort:
0.25mg/2ml, 0.5mg/2ml and 0.5mg/1ml

2. Budexan:

0.5mg/2ml and 1mg/2ml

➤ **Adrenaline nebulizer**

1. **L-epinephrine** (adrenaline concentration (1mg/1ml) referred as 1:1000)
 - a. less than 4 years nebulized epinephrine dose should be 2.5 mg per dose diluted in 4-5ml normal saline
 - b. 4 years and older patients 5mg dose is sufficient with no more dilution
2. **Racemic dose:** 0.05ml per kg (max 0,5ml) of 2.25 %solution diluted to 3 ml saline

There is evidence that L-epinephrine is equally effective as racemic epinephrine and does not carry the risk of additional adverse effects so The use of L- epinephrine is effective, well tolerated, less expensive and more readily available in many countries and racemic epinephrine is not available outside USA

- **What about heliox** (80% hilum plus 20% O₂)? It not routinely used in sever croup due to low o₂ fraction but used as a trail before intubation

Algorithm of management of viral croup

Plan A for mild cases
(home management)

Indications

- occasional barking cough
- exersional stridor
- RR is normal
- no retraction
- no agitation
- o2 sat is normal

Treatment

Instructions

- child should not be sent day care or school for 3 days to avoid infection
- try to make the infant calm
- keep the head elevated
- avoid smooking at home
- warm clear fluids for cough
- mist therapy (not hot warm humidifier) is allowed
- parents should sleep in the same room with the child

medications

- one single dose of oral or IM dexamethasone.
- or inhaled budesonide(2mg)
- avoid sedatives, decongestant, cough medications, antibiotics
- paracetamol or brufen for fever

Follow up if the patient develops

- respiratory distress
- sever frequent cough
- drooling or difficult swallowing
- fever $>39^{\circ}$ for 2 days
- persistent croup >7 days

Algorithm of management of viral croup

Plan B for moderate cases (ward)

Indications

- frequent barking cough
- stridor at rest
- RR: mild tachypnea
- mild retraction
- no cyanosis
- intermittent irritability
- O_2 sat is normal

Treatment

ER

- Single dose of dexamethasone or inhaled budesonide (2mg)
- nebulized adrenaline
- Can be repeated after 15 min
- Humidified O_2 if $SpO_2 < 92\%$

Improved

- discharge with the same instruction and warning signs of plan A
- follow up 24 hrs

not improved

- ward admission
- another dose of dexamethasone after 24 hours
- adrenaline nebulizers every 6, frequency can be up to 12 hours
- O_2 support if $SpO_2 \text{ sat} < 92\%$
- IVF if the patient cannot take oral
- No need for antibiotics.
- If the patient not improved check for other causes & if deteriorating Admit PICU.

Algorithm of management of viral croup

**Plan C for sever cases
(ICU management)**

Indication:

- continuous barking cough
- stridor at rest
- RR: sever tachypnea
- sever retraction (in drawing of sternum)
- cyanosis may occur
- continuous agitation
- spo2 <92%

Treatment

ER: as moderate cases

improved

✓ ward treatment

not improved

✓ check for other causes and investigations done according to clinical assessment and admit in PICU

ICU management

- supportive o2 with spo2 management
- monitor to RR, HR
- continue ward management
- adrenaline nebulizers can be even every 2 hrs or less under continuous cardiac monitor
- if intubation indicated so take care of the following precautions

- ✓ 1. anesthesiologist should be called for intubation
- ✓ 2. skilled ENT consultant to be ready for urgent tracheostomy and for his consultation about other causes of stridor and for further indication
- ✓ 3. use inhalational not IV muscle relaxants
- ✓ 4. size of used tube is .5 to 1cm less than typically used.
- ✓ 5. nebulized adrenaline and IV dexta (0.5 mg/kg/dose 6-12 hours prior to extubation then every 6 hours for 6 doses after extubation)

2-BRONCHIOLITIS

Definition:

Bronchiolitis is an acute inflammatory injury of the bronchioles that is usually caused by a viral infection (most commonly respiratory syncytial virus). This condition may occur in persons of any age, but severe symptoms are usually evident only in young infants.

Incidence:

20% (one from 5 infants).

Diagnosis

History:

1. Diagnosis of bronchiolitis is made on clinical basis.
2. Usually the baby developed a prodroma of low grade fever, running nose and mild cough.
3. 2-3 days later develops progressive cough, shortness of breathing, wheezes and difficulty of feeding.

Peak severity is usually at around day 2-3 of the illness with resolution over 7-10 days. The cough may persist for weeks.

Severe cases progress to respiratory distress with tachypnea, nasal flaring, retractions, irritability, apnea and possibly cyanosis.

Examination:

The diagnosis of bronchiolitis is based on clinical presentation, the patient's age, seasonal occurrence, and findings from the physical examination, which may reveal the following:

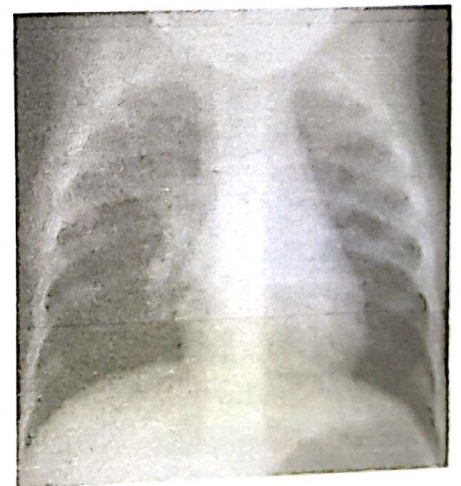
- There is variable degree of respiratory distress.
- Wheezes are the main auscultatory finding.
- Crepitation may be heard.
- Otitis media may be associated.

Investigation.

1. Chest x-ray:

- It is not routinely recommended for all cases.
- It is indicated for severe cases or when diagnosis is not clear.
- It shows hyperinflation of the lungs, in some cases segmental collapse can be seen.

2. No other lab. Investigations are required.



Management

You have to classify the patient of bronchiolitis into one of three groups:

- | | | |
|-----------------|-------|---------|
| • Home- treated | | Plan A, |
| • Ward- treated | | plan B, |
| • ICU – treated | | plan C. |

Plan A for home treated patients:

Indications:

- Typical clinical features of bronchiolitis.
- Age 3 months up to 2 years.
- RR is less than 60 /min.
- O₂ saturation more than 92% at room air.
- Baby can take orally.
- Smoke – free home.
- Parents are able to care the baby at home.

Treatment:

1. **Nasal drops** (normal saline) and frequent nasal suction provide relief of respiratory distress.
2. **Position:** the baby is more comfortable if sit with head and chest elevated at 30° angle and neck is extended.
3. **Feeding:** give more frequent small breast feeds.
4. **No smoking:** at home or around the baby as passive smoking make breathing problem worse. We must notice that smoke remains on clothes even if parents smoke outside.
5. **Medication:**
 - a. No medication are recommended.
 - b. Antibiotics and cough medications are not indicated.
 - c. Bronchodilator and anti-inflammatory drugs are not included in plan A.
6. **Follow up:** all patients must have follow up within 24 hours.

Plan B (ward cases)

Indication of ward admission:

- Age: less than 3 months.
- Tachypnea RR more than 70.
- O₂ saturation less than 92%.
- Inability to take oral feeding.
- Risk groups: (congenital heart disease, baby with premature labor <34 wks, cystic fibrosis, BPD, immune deficiency).
- Parents unable to care their baby at home.

NB: If the respiratory rate between 60-70/min please look for other parameter like feeding difficulties, subcostal retractions or O₂ saturation to take the decision for hospital admission.

Treatment:**1. O₂ therapy:**

- O₂ supplementation is recommended to maintain O₂ saturation more than 92%.
- Nasal prong (flow 0.5- 2L/min) is used, we have to be sure the nasal prong is well fitted on the baby nostril.
- Facial mask (O₂ flow 5- 10L/min) is suitable to bigger infants.
- Head box (less common): indicated for irritable infant with nasal prong, O₂ flow more than 5 L/min.

2. Hydration and feeding

- If the patient can take oral, continue breast or artificial milk feeds.
Saline nasal drops before feeding help the baby to take easier oral feeds
- If the baby cannot take oral:
 - 1 Insert nasogastric tube.
 - 2 Calculate the daily milk requirement
 - 3 Divide the total volume into 3 hourly feeds.
 - 4 Each feed is given by syringe.
 - 5 If the baby cannot tolerate the total volume of milk, you restrict the amount into 70 %.

3. Suction:

nasopharyngeal suction is an essential part of treatment of bronchiolitis.

4. Bronchodilators and Anti-inflammatory agents:

Lack of evidence based medicine support for medical treatment of bronchiolitis make all drugs used are controversial.

However, the following stepwise treatment is recommended:

Step I: combination of adrenaline nebulizer and dexamethasone administration

- Nebulized adrenaline:
 - Dose: 0.1 - 0.15 ml/kg.
 - Frequency every 12 hours.
 - If no improvement within 24 hours may increase frequency each 6 hours.
- Dexamethasone:
 - 0.6 mg/kg/dose (IV or IM or oral) every 12 hours.

Step II:

- Nebulized hypertonic saline.
- Can be added to step I from the start or if the patient is not improving.
- It is safe, inexpensive and effective.
- Dose: 3ml.
- Frequency: every 4-6 hours.

Step III:

- Salbutamol nebulizer:
 - ✓ It is not the drug of choice for treatment of bronchiolitis, and nebulized adrenaline is more effective than salbutamol nebulizer.
 - ✓ Can be added to above treatment if the patient is not improving.
 - ✓ is continued only for patients who give clinical response.
 - ✓ If no response, it is better to discontinue the treatment as it can lead to agitation and ventilation perfusion mismatching.

5. Antibiotics:

Are indicated only if there is secondary bacterial infection evident by:

- Hyperpyrexia ≥ 39 with leukocytosis $> 20,000/\text{cm}^3$.
- Lobar pneumonia on x ray.
- Concomitant otitis media (ceftriaxone is the drug of choice for 3 days).

6. antiviral:

Ribavirin nebulizer only for risk groups but is not available in Egypt.

Plan C: (ICU cases)**Indication:**

- Severe respiratory distress..... severe retraction and cyanosis.
- Apnea.
- O₂ saturation less 90% at room air.
- Impaired mental status.
- Persistent O₂ desaturation less 92% in spite of facial O₂ delivery.

Treatment:

1. X ray chest if it is not done
2. ABG, CBC, blood culture urea, creatinine and electrolytes.
3. O₂ therapy:
 - a. CPAP: is modality of choice in treatment of bronchiolitis.
 - b. Mechanical ventilation:
Please note that child with bronchiolitis looks so distressed, but they do very well and hardly need mechanical ventilation, please observe, observe and observe.
4. Fluid therapy:
 - Infants with bronchiolitis are mildly dehydrated because of decreased fluid intake and increased fluid losses from fever and tachypnea.
 - Avoid excessive fluid administration, because this may promote interstitial edema formation, particularly if a component of inappropriate antidiuretic hormone release is present.
 - Accordingly, it is vital to maintain adequate hydration. The goal of fluid therapy is to replace deficits and to provide 70% of maintenance requirements.
5. Combined dexamethasone and nebulized adrenaline.
6. Antibiotics: As ward management.

Discharge criteria

- The ability of the caretaker to manage the infant's nasal congestion.
- Respiratory rate lower than 60 breaths/min and a resting oxygen saturation above 92% without supplemental oxygen.
- Adequate oral intake.
- The education and confidence of the caretaker.

Key points to remember

- Babies need to rest and drink small amounts more often.
- Bronchiolitis is an infectious disease in the first few days of illness.
- It is more common in babies under six months old.
- Babies are usually sick for three to five days, and then recover over the next seven to 10 days. The cough may continue for two to four weeks.
- Smoking in the home increases the chance of babies having bronchiolitis and will make it worse.

Drugs used in bronchiolitis

1. Adrenaline nebulizer
 - (5 L.E / amp) (1mg/1ml)
 - Dose: 0.1 ml/kg/dose + 2ml saline for each nebulizer /12 hr (amp. For each 10 kg).
2. Dexamethasone.
 - Dexamethasone amp (8mg/2ml) (4LE for amp).
 - Epidron amp (8mg/2ml)(4.5 LE for amp).
 - Orazone syp (0.1mg/ml) (9L.E).
 - Dose: 0.6 mg/kg/dose every 12 hours for 5 days.
3. Hypertonic saline (500 ml, 20 L.E)
 - 3 ml for each nebulization / 4-6 hours.
4. Nasal spray:
 - physiomer nasal spray baby (natural and isotonic seawater).(80 L.E).
 - sinomarin nasal spray.(60 L.E).
 - Dose: one spray for each nostril / 8hours.
5. nasal drops:
 - Lyse baby saline (4 L.E).
 - Otrivin baby saline (7 L.E).
 - Salinex nasal drops (5 L.E).
- 6 Nasal aspirator;
 - Baby nadif aspirator (132 L.E).
 - Nasal aspirator (from 10 L.E to 70 L.E).

Algorithm for treatment of acute bronchiolitis

Plan A

- home treatment (for mild cases)

Indications

- typical features of bronchiolitis
- age : 3months up to 2 years
- RR: <60/min
- O2 sat: >92%
- baby can take oral feeds
- smoke free home
- parents able to care baby at home

Treatment

- saline nasal drops & suction
- sit with head and chest elevated at 30 degree with extended neck
- frequent small breast feeds
- no smoking at home
- no medications are recommended

- all patients must have follow up with in 24hr

Plan B

- Ward treatment (for moderate cases)

Indications

- <3months age
- RR > 70/ min
- O2 sat < 92%
- inability to take oral
- parents unable to care baby at home
- risk groups:
 - premature labors
 - cystic fibrosis
 - BPD
 - immune deficiency
 - cong heart diseases.

NB: If the respiratory rate between 60-70/min please look for other parameter like feeding difficulties, subcostal retractions or O2 saturation to take decision for hospital admission.

Treatment

- O2 supplementation to keep O2 sat > 92%
- small breast feeds if baby can not take oral , insert NGT
- saline nasal drops and nasal suction
- nebulized adrenaline / 12 hr
- dexamethasone oral or IV / 12 hr+
- hypertonic saline nebulized / 4-6 hr
- nebulized farcolin is not the drug of choice but can be used as a trial if patient is not improved
- antibiotics only for:
 - high fever
 - localized patch on X-ray
 - concomitant otitis media

Algorithm for treatment of acute bronchiloitis

Plan C (for sever cases)

ICU treatment

Indications

- Grade III -IV respiratory distress.
- apenic episodes.
- O₂ sat <90%.
- persistent O₂ desaturation <92% inspite facial O₂.
- impaired mental state.

management

- X-ray chest if it is not obtained.
- CBC, CRP, Urea/creat. and electrolytes
- ABG
- O₂ therapy:
 - ✓ CPAP with monitoring O₂ saturation.
 - ✓ Cases usually improve on CPAP and hardly need for MV
 - ✓ Do not be hurry for MV
- IVF ; if baby is dehydrated, correct deficit and provide maintenance.
- Medications: as ward treatment.

3-ACUTE BRONCHIAL ASTHMA

Definition:

Asthma is a chronic inflammatory condition of the lung airways resulting in episodic airflow obstruction, it leads to airways hyperresponsiveness to provocative exposures that leads to recurrent episodes of wheezing, breathlessness, chest tightness and coughing particularly at night. This airflow obstruction is often reversible either spontaneously or with treatment.

Diagnostic features :

Features Make diagnosis of asthma more likely in a wheezy child:

- One of the following symptoms : wheezes , cough , difficult breathing or chest tightness particularly if these symptoms are :
 - Frequent and recurrent , worsen at night and in the early morning.
 - Occur in response to, or are worse after, exercise or other triggers such as exposure to pets, smoke, perfumes, cold or damp air, or with emotions.
- Personal history of atopic disorder especially allergic rhinitis.
- Family history of atopic disorders and/or bronchial asthma (is the most clearly defined risk factor for atopy and asthma in children).
- History of improvement of symptoms or lung functions in response to inhaled SABA.

Features Make diagnosis of asthma less likely in a wheezy child:

- Symptoms present since birth or perinatal lung problem (congenital as tracheo-bronchomalacia or vascular ring).
- Excessive vomiting (Gastroesophageal reflux disease).
- Persistent wet or productive cough (Immotile cilia syndrome, primary ciliary dyskinesia).
- Failure to thrive (cystic fibrosis , immunodeficiencies).
- Unexpected clinical findings as focal signs, abnormal voice or cry, dysphagia , inspiratory stridor (vocal cord dysfunction, vocal cord paralysis, mass).
- Abrupt onset of wheezy chest after episode of choking especially if unilateral wheezes (Foreign body aspiration).

Assessment of acute asthma severity depends on the following parameters:

1. **General look , to assess :**
 - a. Respiratory rate and use of accessory muscles.
 - b. Level of consciousness.
 - c. Speech pattern.
2. **Add pulse oximeter , to assess:**
 - a. SpO₂.
 - b. Pulse rate.
3. **Auscultation of the chest to assess the degree of wheezes .**

So degree of severity of acute asthmatic exacerbation can be classified into:

➤ **Mild attack:**

- Tachypnea with no retractions.
- Normal conscious level and may be agitated.
- Normal speech pattern.
- SpO₂ >94% on room air.
- Pulse rate : Normal for age(<100 bpm).
- Degree of wheezes: Only end-expiratory.
- PEF > 70%.

➤ **Moderate attack:**

- Tachypnea with mild to moderate retractions.
- Speaks phrases and usually agitated.
- SpO₂ 90%-94% on room air.
- Pulse rate mildly increased (100-120 bpm).
- Degree of wheezes: throughout expiration.
- PEF 40-69%.

➤ **Severe attack:**

- Tachypnea with severe retractions.
- Severe agitation or impaired Conscious Level.
- Unable to talk.
- SpO₂ < 90% but improved on O₂ delivered by nasal cannula or mask.
- Pulse rate markedly increased (>120 Bpm).
- Degree of wheezes: throughout inspiration and expiration or silent chest.
- PEF <40%.

➤ **Impending respiratory failure:**

- Cyanosis and SpO₂ < 90% not improved on nasal O₂ with no retractions (suggesting respiratory muscle fatigue).
- Disturbed Conscious Level. (drowsy or confused).
- Bradycardia.
- Degree of wheezes : no wheezes , silent chest .

Management of acute asthmatic exacerbation (3 Plans ABC)

❖ Management of mild to moderate attack (Plan A)

▪ Home management (Plan A1)

- Inhaled SABA (2-4 puffs by MDI) or
- Nebulized SABA (salbutamol 0.15 mg/kg with a minimum dose of 2.5 mg).
- 2-3 times 20 minutes apart.
- Reassess after 1 hr.

➤ If Improved

Avoid the offending trigger and follow up with pulmonologist.

➤ If Not improved

- ✓ Persistent tachypnea and wheezes .
- ✓ PEFr less than 70% of the child's best.
- ✓ Recurrence of symptoms after 4 hrs from 1st attack.
- ✓ Transfer to the ER.

▪ ER management (Plan A2)

- O₂ supplementation if O₂ saturation less than 94% by face mask or nasal cannula.
- Nebulized SABA once then add ipratropium bromide q20 min up to 3 times.
- Give O₂ therapy for 20 minutes after nebulization to avoid ventilation perfusion mismatch caused by SABA .
- One dose of IM or IV hydrocortisone or oral prednisolone.
- Reassess after 1 hr.

➤ If Improved

- ✓ Discharge home.
- ✓ Continue SABA nebulizer or MDI q4 hrs for 1-2 days.
- ✓ + Oral prednisolone for 3-7 days at home .

➤ If Not improved

- ✓ Hospital ward admission (Plan B) .

❖ Hospital ward management (Plan B)

▪ Indications of hospital admission:

- Moderate attack not improved after proper application of plan A.
- Improved severe attack after application of plan C.

▪ Ward management

- O₂ supplementation by face mask or nasal cannula if O₂ saturation < 94% on room air.
- Inhaled SABA q3 hrs.
- Inhaled Ipratropium bromide q6 hrs.
- IV hydrocortisone q6hrs or oral prednisolone q8 hrs.
- IV fluid if the child can't tolerate oral feeding or dehydrated (2/3 of maintenance therapy).
- Reassess every 12 hrs.

➤ If Improved

- ✓ Continue same treatment for 24 hr.
- ✓ then withdraw gradually the inhalation therapy over 1-2 days .

➤ If Not improved

- ✓ Add budesonide nebulizer q12 hrs.
- ✓ (±) Magnesium sulfate nebulizer q12 hrs.
- ✓ Reassess every 6 hrs.

➤ If improving

- ✓ Continue same treatment for 24 hours then withdraw gradually the inhalation therapy over 1-2 days.

➤ Deteriorating

- ✓ PICU admission (**plan C2**).

❖ Management of severe and life threatening attack(Plan C)

▪ ER management (Plan C1):

- Monitor respiratory rate, heart rate , O₂ saturation .
- Provide O₂ Supplementation by face mask or nasal cannula if O₂ saturation<94% on room air .
- Inhaled SABA plus ipratropium bromide followed by budesonide nebulizer then magnesium sulfate nebulizer 20 minutes apart can be repeated twice if not improved .
- Single dose hydrocortisone (4-5 mg/kg) IM or IV.
- If no response single dose of s.c. adrenaline can be administered.
- Then Reassess.

➤ If imporved

- ✓ Hospital ward admission (**Plan B**) .

➤ If not improved

- ✓ PICU admission (Plan C2) .

▪ PICU management (Plan C2):

▪ Indications of ICU admission:

- Deterioration after hospital ward management (Plan B).
- Severe and life threatening attack not improved on ER management (Plan C1).

▪ ICU management :

• Investigations:

- Chest x-ray.
- CBC, CRP.
- Urea, Creatinine.
- ABG once admitted and after 1 hour of treatment then every 6 -12 hour if the case became vitally stable.
- Electrolytes every 6-12 hours.

- Monitor O2 saturation continuously.
- Monitor vital signs every 30 minutes to 1 hr according to the condition.
- O2 support according to case.
- IV fluids (2/3 maintenance to avoid SIADH) .
- Continuous SABA nebulizer.
- Ipratropium bromide nebulizer q4-6 hrs.
- IV methylprednisolone q6 hrs. .

➤ If not improved

- ✓ stepwise use of

- Magnesium sulfate infusion.
- SABA infusion (Salbutamol infusion).
- LABA infusion (Terbutaline infusion).
- Aminophylline infusion just before intubation.

➤ If not improved

- ✓ Mechanical Ventilation.

Doses of drugs used in management of acute asthma

1. Oxygen:

- Given to all patients with acute asthma exacerbation , if saturation is less than 94% on room air.
- Aim is to maintain O2 saturation above 94%.
- Given by face mask or nasal cannula up to MV in life threatening attacks.

- Better to give nebulizations by oxygen 6 to 8 l/min.
- Give O₂ for 20 minutes after nebulization to avoid ventilation perfusion mismatch caused by SABA.

2. SABA:

➤ Available forms: inhalation

- FrancoLin nebulization solution (6mg/ml).
 - Drop=0.3 mg.
 - Ventolin Respirator solution (5mg/ml).
 - Drop=0.25 mg
- Dose=0.15-0.3mg/kg.
- Dose =1 drop/1- 2kg
 - Minimum dose is 2.5 mg=10 drops to be increased up to 10 mg (2ml) /dose in severe cases with close cardiac monitoring.
 - If given by continuous nebulization dose will be 0.5mg/kg/hr up to 5-15 mg/hr.

➤ If given by intravenous route (PICU).

➤ Available forms: parenteral

- Ventolin amp (0.5mg/1ml).

➤ Dose:

- Bolus 5mic /kg for less than 2 years age.
- 15mic /kg for more than 2 years age (max.dose 250mic).
- Over 15 minutes
- Then continuous infusion 1-2 mic /kg/minute up to 5 mic/kg/minute
- If improved tapering by 1 mic/kg/min each 6 hrs.
- Continue inhaled SABA q 2hrs and ipratropium q 4hrs while titrating SABA infusion is mandatory.
- Needs ECG monitoring and electrolytes monitoring.

3. Ipratropium Bromide:

➤ Available forms:

- Atrovent (0.25mg/2ml) & (0.5mg/2ml).
- Combivent: SABA+Atrovent (2.5mg+0.5mg).

➤ Dose:

- Less than 5 years → 0.25 mg/dose.
- More than 5 years → 0.5 mg/dose.
- Given every 20 minutes with SABA for 3 doses then every 6-8 hrs
- Should not be used as first-line therapy.
- Should be added to β_2 -agonist therapy.

4. Budesonide :

Inhaled steroid

➤ Available forms:

- Pulmicort (0.25mg,0.5mg/2ml).

- Budexan (0.5, 1mg/2ml).

➤ **Dose:**

- 0.25-0.5mg/dose

5. Prednisolone:

Systemic steroid

➤ **Available forms:**

- Xilone, predsol → 5mg/5mg.
- Xilone forte, predsol forte → 15mg/5ml.

➤ **Dose:**

- 1-2 mg/kg/day in divided doses (for 3-7 days).
- Tapering the dose is not needed in 3-7 days course.
- Give steroids in adequate doses in all cases of acute asthma reaching hospitals with moderate or severe attacks.
- The earlier they are given in the acute attack the better the outcome.

6. Hydrocortisone:

Systemic steroid

➤ **Available forms:**

- Solucortef (100mg/2ml).

➤ **Dose:**

- 4-5 mg/kg/dose IV q 6hrs.

7. Methyl prednisolone:

Systemic steroid

➤ **Available forms:**

- Solu-medrol (500mg/1gm).

➤ **Dose:**

- 1-2 mg/kg/dose iv q6-12 hrs for 3-7 days.

8. Adrenaline:

➤ **Available forms:**

- L-epinephrine (1mg/1ml).

➤ **Dose:**

- 0.01mg/kg dose up to 0.5 mg S.C..
- May be repeated after 15-30 minutes.
- Nebulized adrenaline does not have significant benefit over salbutamol nebulization in bronchial asthma.

9. Magnesium sulfate:

➤ **Available forms:**

- Magnesium sulfate amp.
- 10ml amp.=1000 mg.

- 1ml= 100 mg.

➤ **Dose:**

- 25-75mg/kg, maximum dose 2.5 g, given intravenously over 20 min.
- Should be given to children with severe or life threatening attack after all conventional treatment (O₂ therapy, inhaled SABA, inhaled ipratropium and steroids) with no response after one hour.
- One dose usually needed.
- Inhaled magnesium sulfate dose 150 mg/dose nebulization.

10. Aminophylline:

➤ **Available forms:**

- Minophylline (125mg/5ml) amp.

➤ **Dose:**

- 5-6 mg/kg slow bolus over 20 min (max. 500 mg) (if not previously on theophylline) followed by infusion 0.5-1.0 mg/kg/hr.
- Requires ECG monitoring and serum level monitoring daily.
- Some patients with near-fatal asthma or life threatening asthma with a poor response to initial therapy may gain additional benefit from IV aminophylline.

11. Terbutaline:

➤ **Available forms:**

- Brethine (1mg/1ml) amp.

➤ **Dose:**

- 2-10 mic/kg slow bolus over 20 minutes followed by infusion 0.1-0.4 mic/kg/min.
- Titrate in 0.1-0.2 mic/kg/min increments every 30 min depending on clinical response.
- Needs cardiorespiratory monitoring , blood pressure and serum potassium.

12. Antibiotics

- When an infection precipitates an exacerbation of asthma it is likely to be viral. The role of bacterial infection has been overestimated.
- Routine prescription of antibiotics is not indicated for acute asthma.

Algorithm for treatment of acute asthma

- Mild to moderate attack

Plan A

Home management (Plan A1)

- Inhaled SABA (2-4 puffs by MDI)
OR
- Nebulizer 0.15 mg/kg salbutamol
(Minimum dose 2.5 mg)
q 20 min for 3 times

Improved

Avoid the offending trigger and follow up with pulmonologist

Not improved

- persistent tachypnea and wheezes
- PEF < 70%
- Recurrence after 4 hrs from 1st attack)

ER management (Plan A2)

- O₂ supplementation if O₂ saturation < 94% by face mask or nasal cannula
- Nebulized SABA once then add ipratropium bromide q20 min for 3 times
- IM , IV hydrocortisone or Oral prednisolone PRN

Improved

- Discharge home
- Continue SABA neb. q4hrs for 1-2 days
- +oral prednisolone q8hrs for 3-7 days

Not improved

Hospital ward admission (PlanB)

Hospital ward management (Plan B)

- O₂ supplementation if O₂ saturation <94% by face mask or nasal cannula
- SABA neb. q3hrs
- ipratropium bromide neb. q6hrs
- IV hydrocortisone q6hrs or oral prednisolone q8hrs
- IV fluids if patient is unable to take oral (2/3 maintenance therapy)
- Reassess every 12 hrs

improved

Continue same treatment for 24 hrs
Then withdraw gradually the inhaled therapy over 1-2 days

Not improved

Add budesonide nebulizer q12hr
(+/-) Magnesium sulfate nebulizer q12hr
Reassess every 6 hrs

Deteriorating

PICU admission
(plan C2)

Improved

Continue same treatment for 24 hrs
Then withdraw gradually the inhaled therapy over 1-2 days

Not improved

PICU admission (plan C2)

Severe or life threatening attack

Plan C

ER management (PlanC1)

Monitor respiratory rate, heart rate O₂ saturation

O₂ Supplementation by face mask or nasal cannula if O₂ saturation <94% on room air

Inhaled SABA plus ipratropium bromide

Followed by budesonide nebulizer

Followed by magnesium sulfate nebulizer

20 minutes apart can be repeated twice if not improved.

One dose of IM or IV hydrocortisone.

If no response single dose of S.C. adrenaline can be administered

Improved

If not improved

Hospital ward admission
(Plan B)

PICU management (PlanC2)

Chest x-ray

CBC, CRP

Urea, Creatinine.

ABG once admitted and after 1 hour of treatment then every 6-12 hour if the case stabilize

Electrolytes every 6-12 hours

Monitor O₂ saturation continuously

Monitor vitals every 30 minutes to 1 hr according to the condition

O₂ support according to case

IV fluids (2/3 maintenance to avoid SIADH)

Continuous SABA inhalation

Ipratropium bromide nebulizer q4-6 hrs.

IV methylprednisolone q6 hrs

If not improved stepwise use of

Magnesium sulfate infusion

SABA infusion (Salbutamol infusion)

LABA infusion (Terbutaline infusion)

aminophylline infusion just before intubation

4-PROTOCOL FOR MANAGEMENT OF COMMUNITY ACQUIRED PNEUMONIA (CAP)

- CAP is one of the common infectious diseases in pediatrics.
- It kills about 3 million child worldwide each year.
- It account for about 20% of death among children.

Causes:

A big list of organisms can cause CAP. We have pointed on the following:

A. Viral pneumonia:

- Is the commonest.
- Become prominent in infancy after 1st year as bronchiolitis is the dominant.
- RSV and influenza viruses are the major pathogens.

B. Pneumococcal pneumonia:

- Is the commonest bacterial pneumonia among all age groups and account for 30- 50% of cases.

C. Staph pneumonia:

- It accounts for 3- 5% of CAP and should be considered as the 1st incriminated organism for cases of fulminant complicated bronchopneumonia.

D. Chlamydia & pertussis pneumonia:

- Should be considered as common organisms causing pneumonia at age of one to 3 months.

Age of patient is essential for prediction of causing organism of CAP

E. Mycoplasma pneumonia:

- It is the commonest cause of CAP in school children and adolescence..

F. Gram negative organism, fungal and pneumocystis carinii:

- Should be in mind in immunocompromised child with CAP.

Step Wise Management Of CAP Can Summarized In 4 Steps:

Step I: diagnosis.

Step II: investigation.

Step III: site of care.

Step IV: plan of management.

Step I (Diagnosis of CAP)

History:

- Record the age of patient.

- Typical history is usually a trait of :
Fever, cough and tachypnea.
- But we must notice that:
 - Pneumonia may be a febrile as chlamydia and mycoplasma.
 - Absence of tachypnea make the diagnosis of patient of pneumonia is unlikely but you have be minded with other clinical disorder presented with tachypnea in DD as congestive heart failure and metabolic acidosis.
 - Pneumonia may associated with vomiting , diarrhea and inability to take oral feeding or medication.

➤ Examination:

Examination of the chest for:

A- Evidence of respiratory distress

- Grade I: tachypnea:
- Grade II: retraction.
- Grade III: Grunting.
- Grade IV: cyanosis.

Classify your patient into 1 of 3:

- Non severe pneumonia G I RD.
- Severe pneumonia G II – III RD.
- Very severe pneumonia G IV RD.

B- Examination for evidence :

- Bronchial breathing.
- Crepitation.
- Diminished air entry.

C- Pulse oximeter: to determine the O₂ saturation of each patient.

Occult pneumonia:

pneumonia without positive chest finding, it was found that 25% of febrile children with temperature ≥ 39 with a WBC count more than 20,000 mm³, without any lower respiratory tract findings on examination, had radiographic evidence of pneumonia.

It is recommended to do CBC and x ray chest children presenting for fever ≥ 39 without an apparent focus.

Atypical presentation of pneumonia:

- Pneumonia should be included in DD of acute abdominal pain.
RT sided lower pneumonia can cause referred pain to Rt iliac fossa, simulating appendicitis like pain.
- Pneumonia should be considered in febrile cases with neck rigidity simulating meningitis.

Step II (investigations)

- CBC, CRP and X- ray chest → For all cases.
- Blood culture only for severe fulminant pneumonia.

4-Protocol for Management Of Community Acquired Pneumonia (Cap)

- Other investigations: will be postponed waiting for the response and prognosis of the case after starting the therapeutic plan.

A. CBC:

- Bacterial pneumonia WBC: 20- 40.000 with a predominance of PNLs.
- Viral pneumonia : WBC not exceed 20.000 with lymphocyte predominance.
- Pertussis pneumonia absolute lymphocytosis.
- Chlamydia pneumonia : increase eosinophilic count.

B. CRP:

- Can't be used as the sole lab marker for DD between viral and bacterial causes of CAP.
- May be used in addition to clinical finding to assess the response to therapy.

C. X- Ray chest:

- It is essential for diagnosis of pneumonia as lobar, interstitial or bronchopneumonia.
- It cannot differentiate the causative organism but it can suggest or support the diagnosis as follow:
 - Viral pneumonia: pulmonary infiltrate and hyperinflation, sometimes segmental collapse, no effusion.
 - Staph pneumonia: bronchopneumonia with pneumatocele or lung abscess.
 - Fungal pneumonia: round (ball like) pneumonic patch.
- Don't repeat x- ray chest during TTT except for
 - Children who fail to respond to TTT within 48- 72 hours.
 - Cases who have progressive deterioration at any stage of therapy.
- Radiological signs of pneumonia resolves within 4- 6 weeks, persistent radiological abnormalities for more than 6 weeks is considered unresolved pneumonia.

Pulmonary ultrasound is more sensitive for demonstration of pneumonia and its complications

D. Blood culture:

- It is positive in only 10 -20 % of cases.
- It is not routinely recommended.
- It is recommended only for critically ill child with toxemia.
- The sicker the patient, the greater the positive results.

E. Other investigation:

- Nasopharyngeal culture: is of limited value as there is poor correlation between it and lower respiratory tract infection.
- Sputum culture: is of little value due to contamination of sputum by flora of the upper air way and it is difficult to get sputum sample from child.
- Broncho alveolar lavage (BAL): need intubation and only recommended for intubated patient on MV.
- Viral study: anti-viral antibodies and PCR are only indicated if there is a specific epidemicity to single virus e.g. avian flu.

Step III: site of care (where will the patient be treated)

Determination the site of care depends on:

- Age of patient.
- Ability to take oral feeds and medication.
- O₂ saturation.
- Severity of pneumonia.

According to above factors, we can classify our patients into 3 groups:

A- Home treated group: indications

- Age more than 6 months.
- Can take oral.
- O₂ saturation more than 92 %.
- No severe pneumonia (RR is normal or GI RD).

B- Ward treated group:

- Age less than 6 months.
- Failure to take oral.
- O₂ saturation less than 92 %.
- severe pneumonia (GII RD or GIII RD).
- family unable to provide adequate care (non-complaint parents).

C- ICU treated group:

- O₂ saturation less than 90 % in spite of facial O₂
- Tachycardia and hypotension need for pharmacologic vascular support.
- Impaired level of consciousness.
- Need for NIPPV or mechanical ventilation.

Estimation of o₂ saturation by oximeter is an essential step to detect the site of care

Step IV (plan of treatment)

Plan A..... for home treated patients

Includes 2 groups:

➤ Plan A1 (for patient aged below 5 years):

- Oral amoxicillin:
 - 90 mg/kg/day (divided into 3 doses q 8 hours) for 5 -7 days, it provides proper cover of pneumococci which is the most common organism.
- Amoxicillin clavulanic can be used as an alternative therapy

NB:

- if there is penicillin allergy: administer cephalosporins (cefprozime, cefuroxime or cefprozil) or macrolid but remember that there is:
 - 1- Low systemic absorption of cephalosporin.
 - 2- Pneumococcal resistance to macrolides.

4-Protocol for Management Of Community Acquired Pneumonia (Cap)

- If there is severe penicillin allergy use levofloxacin.

➤ Plan A2 (For patient aged more than 5 years):

- Azithromycin 10 mg/ kg on day one followed by 5mg/ kg once daily up to 5 day Or
- Clarithromycin 15 mg/kg day in 2 divided doses for 5 days.

It covers the most common organism (mycoplasma) at this age group.

Zinc medication is indicated for all cases of pneumonia:

- Infant less than one year: 10 mg / day.
- Infant more than 1 year: 20 mg /day.

Plan B for ward cases

1- Cases can be treated with empiric combinations of

- Ampicillin : 50 mg/kg iv every 6 hour.
Plus
- Gentamicin : 7.5 mg/ kg iv once /day.

2- If the age of patient is one month to 3 month or above 5 years, add a Macrolide like azithromycin (10 mg/ kg oral for 5 days) to the combination of ampicillin –gentamycin, to cover chlamydia trachomatis and mycoplasmal infection.

3- If the patient is not responding to the treatment evidence by:

- persistent fever..
- Still in RD.
- Poor appetite (anorexia).

N.B: no role of bronchodilator nebulizer in the treatment of RD of pneumonia even may be hazardous.

The following steps are recommended:

- Re-evaluate antibiotic therapy as regarding choice and dose
- Clinical assessment of current severity of illness to determine whether higher levels of care are required.
- Repeat x ray chest to assess the extent and progression of the pneumonia or para pneumonic process (e.g. effusion).
- Further investigations as blood culture.
- Change the antibiotic for ceftriaxone 75 - 100 mg/ kg day q12-24h and ampicillin-sulbactam 150 mg / kg /day.

Plan C For ICU cases:

1. 1 – A list of the following investigation should be obtained

- CBC.
- CRP.
- Repeat x ray chest.
- Blood culture.
- ABG.
- Urea & creatinine.
- Serum electrolyte.

- BAL: if the patient is ventilated.
- 2. Antibiotic therapy:
If staph aureus is suspected (multi focal pneumonia, necrotizing pneumonia or cavitory lesion), use:
 - Vancomycin 15mg /kg/dose IV every 6 hour, or clindamycin 40 mg / kg / day (q 6-8 h).
 - Plus Ceftriaxone.If there is no suspicious of staph, manage as following:
 - No previous intake of antibiotic:
 - start ceftriaxone & ampicillin –sulbactam.
 - If no improvement after 48 hour change the ampicillin-sulbactam into Vancomycin.
 - If previous ceftriaxone intake: continue on ceftriaxone and add vancomycin.

Plan D for viral pneumonia:

Viral pneumonia:

- Is the most common cause of CAP in infancy & childhood
- Represent about 1/3 of cases
- RSV is the commonest organism
- Viral pneumonia is suspected in cases with:
 - 1- If condition is preceded with prodroma of low grade fever with rhinitis
 - 2- Persistent cough or worsening cough.
 - 3- Associated with headache, sore throat & myalgia.
 - 4- Lower probability of chest pain but with feeling of more short breath.
 - 5- History of contact with infected birds.
 - 6- X ray bilateral infiltrates.
 - 7- TLC..... lymphocytosis.

Treatment:

- Mainly supportive.
- O2 therapy.
- Fluid therapy.
- Nebulized bronchodilator.
- Antiviral therapy:
 - Should be given as soon as possible to children with CAP consistent with influenza virus infection during widespread local epidemic until confirmation of +ve result.
 - -ve result doesn't exclude influenza disease.
 - Patient gets the maximal benefit if therapy is initiated within 48 hours.
 - Should not be delayed.
 - **Oseltamivir (tamiflu)** (75-mg capsule; 60 mg/5 mL Suspension).

4 Protocol for Management Of Community Acquired Pneumonia (Cap)

Doses:

- 0–8 months old:
 - 6 mg/kg/day in 2 doses.
- 9–23 months old:
 - 7 mg/kg/day in 2 doses.
- > 24 months old:
 - 15 kg: 60 mg/day.
 - 15 to 23 kg: 90 mg/day.
 - 23 to 40 kg: 120 mg/day.
 - 40 kg: 150 mg/day (divided into 2 doses for each group).
- Antibiotic therapy: is not needed in viral pneumonia, however if deterioration of the case occurs consider bacterial infection especially staph organism and add anti staph antibiotic.

N.B: Aspiration pneumonia:

- 1- Ward cases can be treated with ceftriaxone 75 – 100 mg/ kg /day, plus azithromycin.
- 2- ICU cases can be treated with
 - Piperacillin - tazobactam + vancomycin.
 - If no improvement after 48 hour change antibiotics into Clindamycin.

Algorithm for treatment community acquired pneumonia

Plan A

For mild cases (home ttt)

Indication

- Age: more than 6 month
- Can take oral feeding
- RR: is normal or mild increased
- O2 sat: more than 92

Treatment

age

below 5 years

- oral amoxicillin or
- amoxa-clav. for 5-7 days

- above 5 years
- azithromycin for 5 days

Or

- clarithromycin for 10 days

plan B

For moderate cases (ward ttt)

Indication

- Age: less than 6 months
- Failure to take oral feeding
- RR: increased with retraction+ grunting
- O2 sat: less than 92%
- Non complaint parents

Treatment

- Start with ampicillin+ gentamycin for 48h

- Improved: Continue the same ttt For 7-10days

- not improved:

- repeat x-ray
- bl. culture
- clinical reassessment
- change antibiotics int

- Cefotriaxon + unasyn

- Improved :
 - Continue the same ttt For 7-10days

- Not improved :
Transfer to ICU

• If the patient age is between 1-3 month or above 5 year add to above ttt macrolid e.g. azithromycin for 5 days

Algorithm for treatment community acquired pneumonia:

Plan C

For Severe cases ICU ttt

Indication :

- Grade IV RD, cyanosis
- O2 sat less than 90% with O2 supplementation
- Tachycardia and hypotension
- impaired mental state
- need for MV

Treatment

- CBC, CRP
- X-ray & blood culture if are not obtained
- ABG
- Urea, cratinine, electrolyte
- BAL if pt is ventilation
- O2 supp CPAP upto MV
- IVF
- Antibiotics:
 - If staph aureus is suspected:
Vancomycin or clindamycin plus ceftriaxone
 - If not:
 - no previous intake of antibiotic: start cefotriaxone + unasyn if no response give vancomycin+ ceftriaxone
 - previous antibiotics intake: strat vancomycin + ceftriaxone

Plan D

For viral pneumonia
Suspension criteria

- Age: less than 5 years
- Prodromal of fever, cough
- Persistent worsening cough
- History of contact infected birds
- Tachypnea usually severe
- Bilateral interstitial infiltrates on x-ray
- WBCs is normal or increased not more than 20,000 mainly lymphocytes

Treatment

- Mainly supportive
- O2 therapy
- Nebulized bronchodilator
- Antibiotic if no improvement
- Tamiflu is added if there is influenza virus out break

5- PARA-PNEUMONIC EFFUSION (PPE)

Definition:

Pleural effusion is an abnormal collection of fluid in the pleural space.

Causes:

- parapneumonic effusion is the most common cause.
- 40% of children hospitalized with bacterial pneumonia develop PPE.
- Streptococcus pneumonia is considered to be the most common cause for PPE worldwide.
- Staphylococcus aureus is considered the commonest in the developing countries.
- It has two types:
 - Simple P.P.E: free-flowing, sterile.
 - Complicated: empyema.
- Other causes include:

Heart failure is the second most common followed by malignancy, TB, connective tissue disorders, etc.

Diagnosis of parapneumonic effusion:

A. Clinical diagnosis:

I. Symptoms:

- Small: is usually asymptomatic
- Large collection of fluid leads to
 - dyspnea.
 - respiratory distress.
 - dull aching chest pain.
 - cough.

• These symptoms may vary with an alteration in body position.

II. Signs:

- Inspection: unilateral bulge.
- Palpation:

Excessive unilateral fluid accumulation shifts the mediastinum and displaces the trachea and cardiac apex to the contralateral side.

- Percussion: Dullness.

- Auscultation:

- A pleural rub may be the only initial manifestation during the early stage of pleurisy. The rub disappears as fluid accumulates between the pleural surfaces,
- Decreased air entry, decreased vocal resonance.

Any case of pneumonia not responding to antibiotic therapy than 48 hours, must bring our mind to parapneumonic effusion.

B. Investigations:

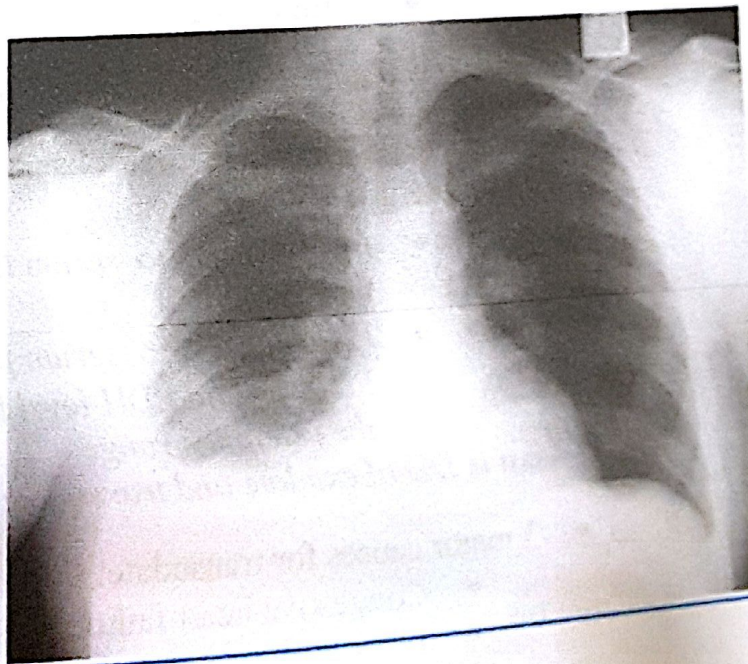
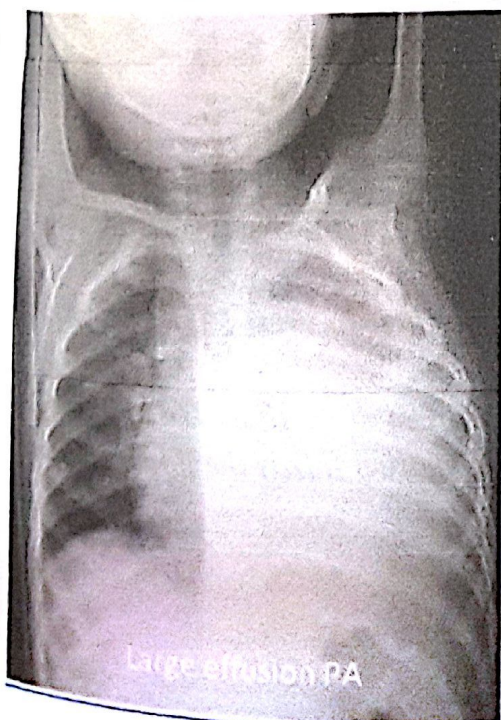
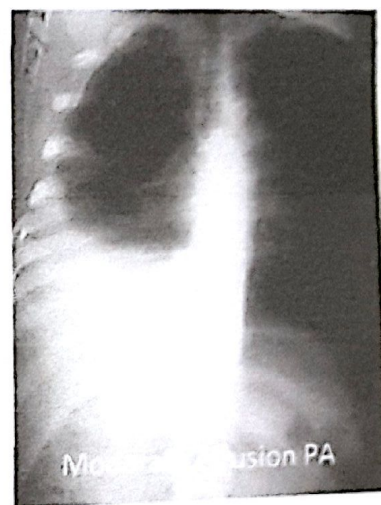
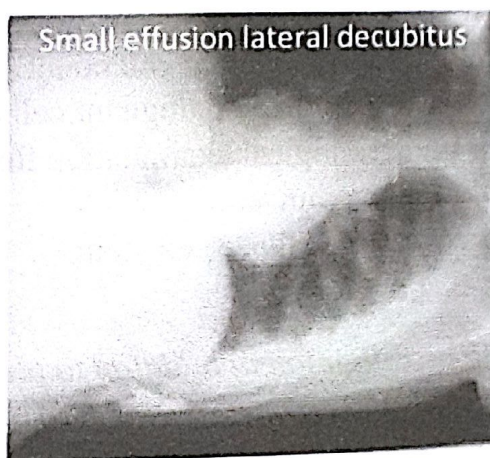
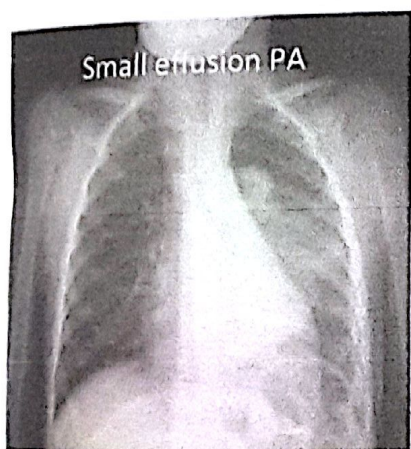
a. Step 1:

1- X-ray chest: P.A view, lateral decubitus.

- Small effusion: less than $\frac{1}{4}$ hemithorax.
- Moderate effusion: more than $\frac{1}{4}$ and less than $\frac{1}{2}$ hemithorax.
- Large effusion: more than $\frac{1}{2}$ hemithorax.

N.B: Lateral decubitus with the affected side down helps for detection of minimal effusion.

Chest U/S: if it is available it will be valuable for presence of loculi or septa which suggest the diagnosis of empyema.



b. Step II investigation:

Thoracocentesis and pleural fluid examination:

Q1: what are indications of thoracocentesis?

- Indications:
 - Moderate to large effusion.
 - Unclear diagnosis.

Q2: what are the aspects of analysis for pleural fluid?

- Chemical;
 - Protein.
 - Glucose.
 - PH.
 - LDH.
 - ADA.
- Cytological examination for:
 - total cell count.
 - Differential cell count.
 - Specific malignant cells.
- Bacteriological examination for:
 - gram stain.
 - Ziehl neelsen stain.
 - C&S.

Q3: Are there lab investigation in addition to pleural examination? Yes

- CBC, CRP, ESR.
- Serum protein.
- Serum LDH.

Q4: how can you differentiate between exudate & transudate?

Fluid is considered exudate if it has at least one of the following (modified Light criteria):

- Pleural fluid-to-serum lactate dehydrogenase (LDH) ratio of more than 0.6
- Pleural fluid-to-serum protein ratio of more than 0.6
- Pleural fluid LDH level increased by two thirds the upper limit of the reference range

Q5: what is DD of exudate and transudate?

- 3 major causes for transudate:
 - Congestive heart failure.
 - Liver cirrhosis.
 - Nephrotic syndrome & connective tissue diseases.
- 3 major causes for exudate:

- PPE.
- T.B.
- Malignancy.

Q6: what is step wise approach for diagnosis of exudate?

- 1- Look at ADA: if it more than 98 IU/L T.B should be considered and PCR or T.B gene study of pleural fluid is recommended.
- 2- If there is specific malignant cells were detected, malignant effusion should be considered especially if:
 - C& S is -ve.
 - Hemorrhagic effusion.
 - Effusion is rapidly accumulated after each drainage.

(Pleural biopsy is indicated)

- 3- If there is no malignant cells and ADA less than 98 IU/L parapneumonic effusion is considered.
- 4- Empyema is considered if there is:
 - PH less 7.2.
 - Glucose less than 60 mg/dl.
 - Presence of pus cells.
 - Especially if US shows loculation or septa.

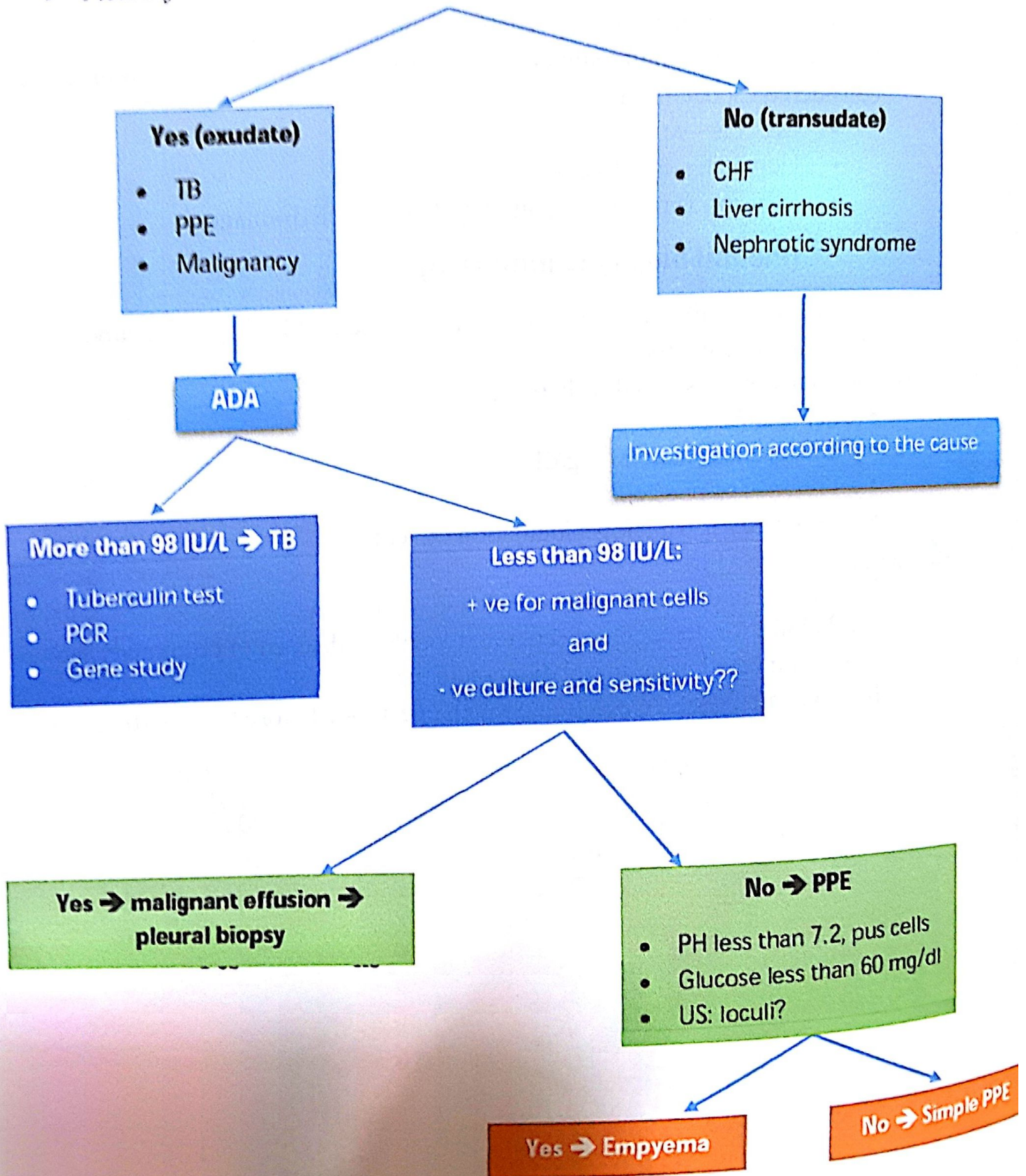
c. Step III: C.T CHEST:

- It is helpful in diagnosis of site and size of effusion.
- It is helpful for detection of septa and loculi in absence of pulmonary US.
- It isn't indicated as an initial diagnostic parameter.
- It is indicated for all cases treated with chest tube before the insertion of tube.

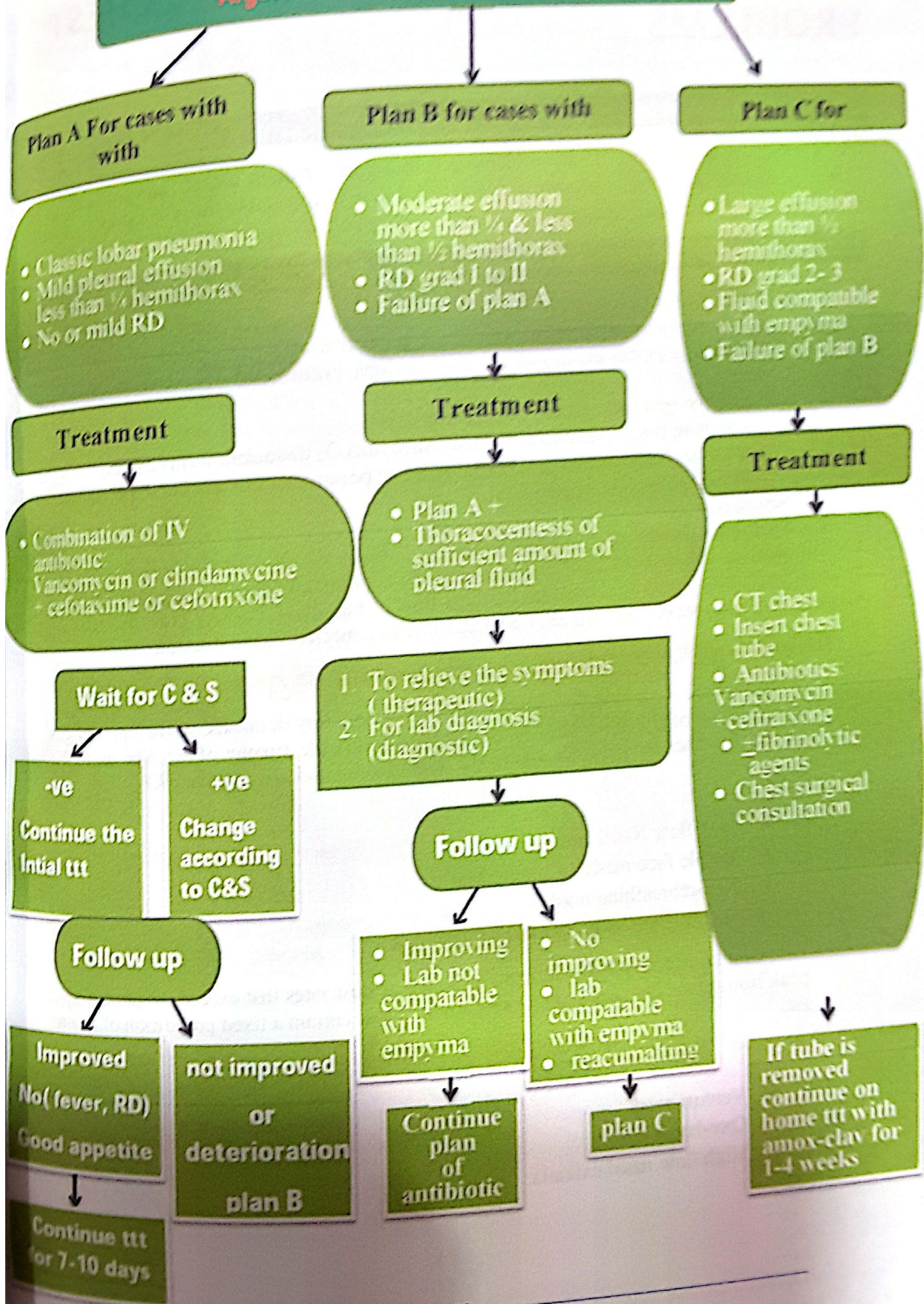
Algorithm for diagnosis of pleural effusion:

Is it exudate by (modified Light criteria)?

- Pleural fluid-to-serum lactate dehydrogenase (LDH) ratio of more than 0.6.
- Pleural fluid-to-serum protein ratio of more than 0.6.
- Pleural fluid LDH level increase by two thirds the upper limit of the reference range



Algorithm for treatment of PPE



6-OXYGEN THERAPY IN PEDIATRIC CHEST PROBLEMS

General Concepts:

Oxygen therapy is the administration of oxygen in a concentration higher than ambient air. This can be done using many accessory devices that deliver oxygen to the respiratory system with different efficacy and reliability.

Indications of Oxygen therapy:

1. Arterial hypoxemia:
 - Low oxygen in inspired air, Alveolar hypoventilation, or $\uparrow$ O_2 consumption
 - Ventilation-perfusion mismatch (acute asthma, pneumonia, atelectasis, R $\rightarrow$ L shunts)
2. Failure of oxygen hemoglobin transport system
 - Inadequate tissue perfusion, anemia, Abnormal O_2 dissociation curve (CO poisoning, hemoglobinopathies), Histotoxic poisoning of intracellular enzymes (cyanide poisoning, septicemia)
3. Severe trauma.
4. Short-term therapy (e.g., post-anesthesia)

Oxygen delivery systems can be of ambient pressure or of positive pressure support. The ambient pressure systems are classified into low flow or high flow. Positive pressure oxygen support: non-invasive (CPAP, BiPAP, PSV) and invasive mechanical ventilation

A. Low flow oxygen delivery (variable performance system):

They Provide oxygen at flow rates $<$ patients' inspiratory demands, so the inspired gas is a mixture of the delivered O_2 diluted with a variable amount of air. The more the patient breathes the more air dilutes the delivered O_2 and lower is the FiO_2 .

Types:

- Low-flow Nasal cannula
- Simple face mask
- Non-rebreathing mask

B. High-flow or fixed-performance devices:

Provide a constant FiO_2 by delivering the gas at flow rates that exceed the patient's peak inspiratory demand and by using devices that entrain a fixed proportion of room air.

Types:

- Venturi mask.
- Oxy-hood.
- High flow nasal cannula.

Oxygen Therapy In Pediatric Chest Problems

	System	Characters	FiO ₂
Low flow devices	Low-flow Nasal cannula	Different sizes for neonates and pediatrics. Flow rate of oxygen 1-6 L/min (max. 2L/min for infants) Humidification is essential Provides flow to upper airway, may help mild distress Cheap, Very Easy to use, comfortable but unreliable FiO ₂	25-50%
	Simple face mask	Clear plastic mask can be molded to fit patient face Flow rate of gas 6-10 L/min provides FiO ₂ 35-60% Unreliable concentration of oxygen	35-60%
	Venturi mask	A mask with high jet of air flow mixed with fixed amount of air to give oxygen enriched gas mixture of stable oxygen content. The amount of oxygen delivered (FiO ₂) varies with its size (color coded) and amount of flow. Reliable concentration of oxygen in the range of 24-60%	24-60%
High flow devices	Oxy-hood	A hood placed over the head, for newborns and infants. Correct size is important to prevent CO ₂ accumulation if small or oxygen dilution if large. High flow is used to prevent rebreathing of CO ₂ (>5 L/min) Not popular in use nowadays.	50-90%
	Non-rebreathing face mask	Combines simple face mask with a reservoir bag and a fresh gas inflow system with valves, allowing delivery up to 100 % oxygen. The exhaled air is directed away from inspired gas mixture. The high flow and the valve system allows a fixed amount of air to be mixed with oxygen. The FiO ₂ depends on the amount of flow (6-15 L/min giving 55-100% oxygen.	55-100%
	High flow nasal cannula	A special device with dedicated tubing to provide heated humidified high flow (HHHFNC). Very good and effective, but expensive.	21%-100%

The selection of method of oxygen delivery will depend on the patient comfort and tolerance and the amount of FiO₂ required.

Usually it is easier to start with one of low flow devices and if needed shift to high flow devices. Start with either low-flow nasal cannula or simple face mask. If insufficient use Venturi mask then non-rebreathing face mask.

CPAP:

- It is continuous pressure applied to the airway non-invasively throughout respiratory cycle to support breathing and to improve gas exchange.
- CPAP should be applied in intensive care unit setting.
- A dedicated device for non-invasive CPAP application is not essential. It can be applied using ordinary ventilators with appropriate tubing system.
- A special CPAP interface (tight fitting face mask with fixation harness) is needed.
- CPAP setting adjustments are: flow, pressure and FiO_2 .
- When using CPAP, it is preferred to open the lung by pressure than to give high FiO_2 .

- ❖ Generally, CPAP is indicated if there is severe lung affection and increased work of breathing (Downe score 4-6 in infants).
- ❖ Persistent hypoxemia ($\text{SpO}_2 < 90$) despite high FiO_2 use ($> 60\%$).
- ❖ Progressive CO_2 accumulation especially with obstructive airway diseases.
- ❖ Consider early in young patients < 3 months.
- ❖ It is better to be used early in the course of some diseases (asthma and bronchiolitis) and this will decrease the need for mechanical ventilation.

Usually CPAP pressure 5-10 cmH_2O is needed.

Start CPAP 5-6 cmH_2O and increase one by one looking for decrease in work of breathing and oxygen requirements.

Once stabilized, and oxygen requirements went down $< 40\%$, go down by pressure one by one till CPAP 5 then it can be weaned. The duration will vary according to severity.

Disease specific notes for CPAP use:

1. Bronchiolitis:

Moderately high CPAP pressure will help to open the airways and open the collapsed alveoli (CPAP 6-10 may be needed). Monitor for improvement in oxygenation and work of breathing.

2. Asthma:

Acute severe asthma (plan C2) not improving on ER therapy and bronchodilators can benefit from early CPAP use. High pressure is needed from the start in these cases (80-90% of intrinsic PEEP) to open the airway and to revert dynamic hyperinflation. The goal in these cases is to improve ventilation and to decrease work of breathing then decrease pressure of CPAP gradually as tolerated.

3. Community acquired pneumonia:

Severe cases (plan C) needing ICU admission with persistent hypoxemia on high FiO_2 may need CPAP. Usually moderate CPAP pressures are needed aiming to decrease the FiO_2 .

4. Pleural effusion:

If massive effusion is to be drained, CPAP can help splinting the alveoli and inflate the collapsed lung preventing re-inflation alveolar edema. Low CPAP pressures are sufficient (5-6 cmH₂O)

Mechanical ventilation:

General rules:

Rapid sequence intubation should be used (atropine, analgesia, muscle relaxant)

Indications for ventilation vary with disease but generally:

1. Impending respiratory failure (oxygen saturation <90% with high FiO₂ >60%, PCO₂ > 60 mmHg or pH <7.25)
2. Increasing work of breathing (Downe score > 6 in infants).
3. Deteriorating level of consciousness.
4. Apnea and bradycardia.
5. Patients who will need intubation for upper airway obstruction (severe croup).

In most of the cases early use of non-invasive CPAP can avoid the need for invasive mechanical ventilation.

Synchronized ventilator mode should be used whenever possible and sedation should be kept to minimum.

The ventilation strategy and settings will vary with diseases and patient condition.

Disease specific notes for mechanical ventilation:

1. Bronchiolitis:

- Moderately high PEEP (>6 cmH₂O)
- PIP just to achieve 6-8 ml/kg tidal volume.
- Appropriate inspiratory time for age with long expiratory time and normal to low rate for age.
- The patient should be stabilized on ventilator for 24-48 hours before attempting extubation.

2. Asthma:

- High PEEP strategy aiming to open the airways and to revert the hyperinflation.
- PIP just to achieve 6 ml/Kg tidal volume.
- Volume ventilation can be a good choice with monitoring of peak pressures. If pressure ventilation is used, PSV is the best mode.
- Long inspiratory time for age and longer expiratory time, thus slow rates are adopted.
- Sedation may need to be used.
- Weaning of the respiratory support may take few days.

3. Pneumonia:

- No specific settings can be applied to all cases of pneumonia. It should be individualized according to the degree of lung affection.

- In cases of severe infection with severe inflammatory lung injury, ARDS-like settings can be used. High PEEP (>8 - 10 cmH₂O), low tidal volume (4-6 ml/Kg), short inspiratory time and high rate for age).
- In cases of heterogenous pathology or unilateral affection, caution should be not to injure the healthy side with ventilator pressures.

4. Viral croup:

- These patients will need very minimal setting as they only have a normal lung and the problem is in the upper airway.
- Weaning will depend upon the resolution of laryngeal obstruction.

5. Effusion:

- Mostly the ventilation need will depend on the accompanying lung disease if any.